

Hare (Robt.)

AN

ATTEMPT TO REFUTE

THE

REASONING OF LIEBIG

IN FAVOR OF THE

SALT RADICAL THEORY.

BY

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AN ATTEMPT, &c.*

1. *Gentlemen*—My attention was lately drawn to two lectures delivered about eighteen months ago, by LIEBIG, in support of the salt radical theory. You are well acquainted with the efforts made by me to refute that hypothesis, in an essay published under your auspices.† Your opinions, as well as those of several of the more distinguished of our American chemists whom I have consulted, have been emphatically expressed in favor of the validity of my reasoning. Nevertheless from the lectures above mentioned, and from a text-book lately published by GREGORY, the successor of HOPE, it appears that, by these eminent professors, innovations are to be supported which have, on this side the water, been deemed indefensible. Under these circumstances, I again raise my voice against this new doctrine, hoping that although an ocean rolls between those who may be led astray and the author of this communication, his warning may be neither unheard nor unheeded.

2. Pursuant to the new doctrine, every oxacid is to be considered as a hydruret of a compound radical, as those heretofore called hydracids are hydrurets of simple radicals, so that both of these classes are to bear the name of hydracids.

3. Agreeably to the nomenclature proposed by DANIELL, the hydrated sulphuric, nitric and phosphoric acids consist of hydrogen in union severally with oxysulphion, oxynitron and oxyphosphion, their formulæ being respectively $\text{SO}^{\circ}\text{H}$, $\text{NO}^{\circ}\text{H}$, $\text{PO}^{\circ}\text{H}$.

4. According to a definition given by LIEBIG, at the close of his second lecture, "*acids are compounds of hydrogen with simple or compound radicals, in which the hydrogen may be replaced by its equivalent amount of metal.*"

5. Inferring that in those oxacids which unite with water as a base, the oxygen of the water goes to form a compound radical, the constitution of these acids is considered as quite analogous to

* In a letter to the Editors.

† See this Journal, for Jan. 1843.

that of the compounds formed with hydrogen by halogen bodies,* whether simple, like chlorine, bromine, iodine and fluorine, or compound, like cyanogen. Hence the term hydracid, heretofore confined to the haloid compounds of hydrogen, and those formed by this element with sulphur and selenium, is to be extended to all the hydrated oxacids. Moreover respecting oxacids which are incapable of uniting with water as a base, the distinguished lecturer holds the following language. "*I maintain that they are not acids. Do you find any of the characteristic properties of the hydrogen acids, in chromic acid, boracic acid, silicic acid, titanitic acid, antimonitic acid, or in their combinations with metallic oxides?*"

6. The lecturer also uses the following language. "*The compound which we denominate hydrated sulphuric acid, possesses properties analogous to hydrochloric acid.*" And again: "*There is no proof that our common sulphuric acid contains water; but we can prove that its chemical character, analogous to that of hydrochloric acid, depends, as in that acid, on the presence of hydrogen. We can prove that this hydrogen can be replaced by its equivalent of metal.*"

7. This celebrated author has, in a preceding paragraph, urged "*that the so called anhydrous sulphuric acid, and phosphoric acid, do not possess any of the characteristic properties of acids; these they obtain only by their combination with water.*"

8. As the characteristic properties of "the hydrogen acids" are not only in the instances here cited, but in others, repeatedly insisted on by LIEBIG as a corner-stone of the new system, it is unfortunate that they are no where described. It is to be regretted that LIEBIG does not specify any properties characteristic of acidity, which belong both to the hydrated oxacids and the gaseous

* Chlorine, bromine, iodine, fluorine and cyanogen, are by BERZELIUS distinguished by the generic name halogen, from Greek words which convey the idea of salt and to produce. Common salt, from which the notion of salt first originated, being a binary compound of chlorine and sodium, all other binary compounds of chlorine, or of any of its congeners which belong to his halogen class, are called salts, and the compounds of these double salts, although there are no bodies in nature more dissimilar in their properties than some of those thus constituted; as for instance the gaseous compounds formed with hydrogen, the volatile liquid and fuming chlorides of tin and arsenic, the butyraceous chlorides of zinc, bismuth and antimony, and such inert chlorides or fluorides as horn silver, horn lead, and fluor spar.

"hydracids" (so called) formed by the union of hydrogen with the halogen bodies of BERZELIUS. Neither the latter nor the former, while undiluted, are endowed with sourness, nor with the ability to redden litmus; and were they thus endowed, it could not be of any importance to the argument, since according to LIEBIG, "*We have long since abandoned the position, that mere reaction with test paper should decide whether or not a body should be called an acid or not.*" But if reaction with test paper be thus set aside, the inferior test of sourness cannot but share the same fate.

9. It seems to me that there has been a lamentable deficiency of precision in LIEBIG's expressions respecting the resemblance between the hydrated oxacids and the haloid* hydracids. I call upon him, or any of the advocates of the salt radical theory, to point out any peculiar attributes of acidity belonging to them in common. The whole source of this idea would seem to be a vague conception, that the vulgar attributes of acidity belonging in common to diluted sulphuric and diluted muriatic acid, are attributable to the hydrogen of the basic water in one case, and that of the hydrogen of the gaseous chloride in the other. But to lay any stress on this resemblance, is irreconcilable with the above quoted allegation of the celebrated author, that the effect upon test paper is no longer to be considered as an evidence of acidity. Yet besides this attribute and that of sourness, what other common properties, distinctive of these diluted acids, can be imagined? The evolution of hydrogen by reaction with metals, cannot avail unless water, equally capable of that reaction, be made an hydracid, and oxygen consequently transferred to the halogen class. But if this transfer be made, the salts heretofore considered as simple amphide salts, become as well entitled to be deemed double haloid salts, as any of the double chlorides.

10. Is it not evident that the whole of this salt radical doctrine, as presented by LIEBIG, is founded on an unnatural and arbitrary peculiarity attached to oxygen on one side, and to hydrogen on the other, by which each of these elements is treated as a body *sui generis*? Upon what rational ground is oxygen separated from the other electro-negative elements forming the amphigen and halogen bodies of BERZELIUS?

* A haloid compound is one which contains a halogen body as an ingredient.

11. If chlorine be a simple radical, wherefore is not oxygen a simple radical? But if oxygen be a simple radical, agreeably to LIEBIG's definition above quoted, (3,) water, the oxide of hydrogen, is as much entitled to be considered as an hydracid, as muriatic acid, (the chloride of hydrogen.) The oxide, no less than the chloride, consists of a "*radical in combination with hydrogen in which the hydrogen may be replaced by a metal.*" Hence, as no rational line of demarcation can be drawn about oxygen, so as to separate it from its congener chlorine, it follows either that all the compounds consisting of two chlorides, and hitherto called double chloro-salts by BERZELIUS, are consistently simple chloro-salts; or, that all compounds consisting of two oxides and called simple, should be considered as double oxysalts.

12. The supposed hydracids, consisting of oxacids containing only basic water, being liquid, while the hydracids proper, when equally devoid of water, are æriform; had the comparison been made between them, neither being associated with water as a solvent, the idea of any similitude could hardly have arisen. Besides unless so associated, they are generally insusceptible of change by reaction with metals without heat, and when subjected to decomposition, there is no analogy in the result. In the case of hydracids proper, the halogen body uniting with any metal presented to it, hydrogen is evolved; but in that of the hydrated oxacids, the alleged compound radical is decomposed with an evolution of some combination of the non-metallic ingredient with oxygen. Thus instead of hydrogen, sulphuric acid yields sulphurous acid, nitric acid yields nitric oxide. It follows that the presence of basic water alone, does not fulfill the conditions of LIEBIG's definition, since *per se* the hydrogen entering into combination with the alleged compound radical, cannot be replaced by a metal.

13. It may be expedient here to advert to the fact that in the case of magnesium and aluminium, oxygen plays the same part in taking place of chlorine and causing the *chloride* of hydrogen to be evolved, that chlorine performs in the cases of various oxides in which oxygen is replaced by chlorine and the *oxide* of hydrogen is evolved. Again, the reaction of muriatic acid with any bromide or iodide of which the metallic ingredient prefers chlorine to bromine or iodine, is analogous to the reaction of the same hydracid with certain oxides which prefer chlorine to oxygen.

14. It is therefore clear that in the reaction of haloid compounds with each other and with oxides, there is a perfect analogy, and that the erection of a special genus for oxygen is unjustifiable. This conclusion is fortified when oxygen is considered in relation to sulphur or selenium, with which it is classified by BERZELIUS. There is, as I think, also a perfect analogy between the reaction of water with certain metallic sulphides, and of muriatic acid with certain oxides; and I presume that the same may be said of the reaction between water and some selenides.

15. As respects the propriety of holding up hydrogen as an element *sui generis*, the advocates of the salt radical doctrine do not agree with each other; since according to KANE, and GRAHAM also if I remember right, hydrogen is an aëriform metal, an opinion which I embraced independently more than twenty years since. But I trust that in my essay above alluded to, LIEBIG's reasoning in reference to this question is shown to be founded upon this palpable inversion of the truth, that the capacity of acidifiable radicals for metals is assumed to be dependent on the quantity of hydrogen with which they are capable of combining; instead of the quantity of hydrogen which can unite with them, being directly as their capacity for it or any other body in the table of equivalents.*

In a communication which I intend to send you for the next number of your Journal, I hope to proceed with the refutation of LIEBIG's reasoning.

* See paragraphs ninety one, &c. in my Essay in this Journal, for Jan. 1843.

